Independent Financial Advisor Report
To California High-Speed Rail Authority Regarding:

Central Valley Segment Funding Plan

Project Finance Advisory Ltd. (PFAL)
December 8, 2016

PFAL Project Finance Advisory Ltd.


PFAL

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Key Terms and Definitions

AB 1889: Assembly Bill No. 1889, Stats. 2016, ch. 774

Authority: California High-Speed Rail Authority

DB: Design Build

FTA: Federal Transit Administration

Funding Plan: Central Valley Segment Funding Plan

High-Speed Train Operation: Authority high-speed train service as envisioned in the 2016 Business Plan and Ridership and Revenue Forecasting Technical Supporting Document to the 2016 Business Plan.

HSR: High-Speed Rail

OHLE: Overhead Line Equipment

Passenger Train Service: Conventional rail service such as San Joaquin service (operated by San Joaquin Joint Powers Authority) between Sacramento, Oakland, and Bakersfield

Phase 1: California High-Speed Rail Program Phase 1, as defined in 2016 Business Plan, from Los Angeles to San Francisco

Prop 1A: Proposition 1A, the Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century, (added by Stats. 2008, ch. 267 (AB 3034)), codified at Streets and Highways Code 2704, et seq.

Report: Independent report pursuant to California Streets and Highways Code 2704.08(d)(2)

SB 1029: Senate Bill No. 1029 Budget Act of 2012

"**Operating and Maintenance Costs**," within the meaning of Streets and Highways Code section 2704.08, subdivision (d)(2)(D)) means: ongoing operating and maintenance costs, that is, the cost of running the trains and maintaining the infrastructure and rolling stock in a state of good repair. It does not include capital asset renewal (or lifecycle) costs, which is the cost of replacing or refurbishing worn out components at the end of their useful life.

"**The planned passenger service to be provided by the Authority, or pursuant to its authority, will not require an operating subsidy**" means: within a reasonable period of time after commencement of high-speed train operations on the usable segment, project revenues will reach an operating break-even point at which aggregate revenues up to that point in time equal Authority-borne operating and maintenance costs to that point in time and such revenues will continue to equal or exceed operating and maintenance costs thereafter.

"**Revenues**," within the meaning of Streets and Highways Code section 2704.08, subdivision (d)(2)(D)) means: fare box revenues and ancillary revenues. Fare box revenue is income from ticket sales. Ancillary revenues include other income the Authority may receive from sources related to the everyday business operations of the high-speed rail, including but not limited to on-board sales (e.g., sales of foods or sundries), station-related revenues, advertising, and revenues from leases of excess or non-operating right-of-way parcels or areas, as well as areas above or below operating rights-of-way or of portions of property not currently being used as operating rights-of-way. Ancillary income does not include unexpected or "one time" events.

"**Suitable and ready for high-speed train operation**" means as stated in Assembly AB 1889 means: if the bond proceeds, as appropriated pursuant to Senate Bill 1029 of the 2011–12 Regular Session (Chapter 152 of the Statutes of 2012), are to be used for a capital cost for a project that would enable high-speed trains to operate immediately or after additional planned investments are made on the corridor or useable segment thereof and passenger train service providers will benefit from the project in the near-term."

"Useable segment" means the 119 mile Central Valley segment from Madera to Poplar Avenue and includes stations at Fresno and Kings/Tulare.

Disclaimer

Project Finance Advisory Limited ("PFAL") has performed an independent review of the Central Valley segment Funding Plan ("Funding Plan") as required by the California Streets and Highways Code 2704.08(d)(2) and as described in PFAL's executed agreement with the California High-Speed Rail Authority ("Authority") dated December 2015. This independent review was performed using documents provided by the Authority (listed in the Bibliography and body of this Report) and developed using current accepted professional practices and procedures. PFAL, with the Authority's permission, has relied on the accuracy and completeness of the documents provided by the Authority. This Report does not serve as an accounting audit. Furthermore, this Report should not be relied on for any financing or investment decision. It is possible that there are other elements of risk associated with the Funding Plan beyond those presented. Any financial estimates, analyses or other information used by PFAL in connection with the Report represents the general expectancy concerning events as of the evaluation date and are based solely on the information reviewed by PFAL. However, the accuracy of any financial estimate, analysis or other information is dependent upon the occurrence of future events that cannot be assured. Additionally, these estimates and analyses rely on the assumptions contained therein, the accuracy of which remains subject to validation, further refinement and future events. Estimates should not be construed as statements of fact. There will usually be differences between the projected and actual results because events and circumstances do not occur as expected, resulting in possible differences.

Executive Summary

Project Finance Advisory Limited ("PFAL"), together with our team of subconsultants, was appointed by the California High-Speed Rail Authority ("Authority") to provide independent consultant services following a competitive procurement process that concluded in December 2015. Our role is to fulfill the legislative requirement to perform independent analysis of the Authority's funding plans and to determine if the funding plans meet the criteria listed below.

This Report provides our independent analysis of the Central Valley segment Funding Plan ("Funding Plan") dated December 2016 developed by the Authority pursuant to California Streets and Highways Code ("SHC") 2704.08(d)(1). The Funding Plan calls for $2.609 billion of Proposition 1A ("Prop 1A") bond proceeds as part of the funding for the Central Valley segment ("Segment"), the 119 mile segment from approximately adjacent to the Madera Amtrak Station to Poplar Avenue, as appropriated in Senate Bill ("SB") 1029.

The purpose of this Report is to fulfill the requirements to review the Funding Plan for the $2.609 billion Prop 1A bond proceeds appropriated in SB 1029 to indicate if:

a) Construction of the corridor or usable segment thereof can be completed as proposed in the Funding Plan;
b) If so completed, the corridor or usable segment thereof would be suitable and ready for high-speed train operation;
c) Upon completion, one or more passenger service providers can begin using the tracks or stations for passenger train service;
d) The planned passenger train service to be provided by the Authority, or pursuant to its authority, will not require an operating subsidy; and
e) An assessment of risk and the risk mitigation strategies proposed to be employed.

As an independent consultant, PFAL and our team of subconsultants have a duty of care to the California State taxpayers to review the Funding Plan and to address the required indications listed above. In keeping with this responsibility, the analysis and conclusions in this Report are not prejudiced by any external interests; our conclusions are completely our own.

The analysis and conclusions provided in this Report are based on our review of material provided to us by the Authority as we describe in this Report. Our analysis and conclusions are based on our professional opinions and the opinions of subconsultants to PFAL that specialize in passenger rail operations and high-speed

rail (“HSR”) delivery. These subconsultants include First Class Partnerships Limited (“FCP”), David Evans and Associates, Inc. (“DEA”), Anrab Associates (“Anrab”), and Infrastructure Development Strategies California (“IDSCA”).

PFAL’s review and development of this Report, as it pertains to forming an opinion for SHC 2704.08(d)(2), is limited in scope to the contents of the Funding Plan (and associated background information). Our role in this Report is not to render an opinion on the SHC 2704.08(c) funding plans or the projects required to complete the overall high-speed rail system outlined in the 2016 Business Plan.

The approach PFAL implemented, further described in Section 1.1, to independently verify the criteria in SHC 2704.08(d)(2) is based on industry best practices and PFAL’s previous roles of comparable assignments as independent financial advisor and auditor for the Federal Railroad Administration’s Railroad Rehabilitation & Improvement Financing (“RRIF”) program, the US Department of Transportation (“USDOT”), the Virginia Office of Public Private Partnerships, and the USDOT’s Transportation Infrastructure Finance and Innovation Act (“TIFIA”) Program, as well as many other government agencies in the US and internationally.

The Funding Plan was developed to satisfy the statutory requirements of SHC 2704.08(d)(1), comply with the appropriations in SB 1029, and fulfill the Authority’s implementation plan as specified in the 2016 Business Plan. The Funding Plan addresses the statutory requirements of SHC 2704.08(d)(1) by providing:

Table 1: Central Valley Segment Funding Plan Summary

SHC 2704.08(d)(1) requirements	Funding Plan Summary
Identification of the corridor or usable segment thereof, and the estimated full cost of constructing the corridor or usable segment thereof	Funding Plan sets out how Central Valley segment qualifies as a usable segment with supporting June 2012 Office of Legislative Counsel opinion (further described below); summarizes the civil works and rail infrastructure elements included in the funding plan; and provides projected capital cost of $7,813 million.
Identification of the sources of all funds to be used and anticipated time of receipt thereof based on offered commitments by private parties, and authorizations, allocations, or other assurances received from governmental agencies	Sources of Funds for the $7,813 million capital cost are identified as $2,609 million of Prop 1A funds, $2,970 of Federal grants, and $2,234 million of Cap-and-Trade proceeds.
Projected ridership and operating revenue report	The Funding Plan provides details of the projected ridership for the San Joaquins service as well as description of the Authority’s need to connect the Central Valley segment to the rest of Silicon Valley

SHC 2704.08(d)(1) requirements	Funding Plan Summary
	to Central Valley Line before high-speed train operations can begin as envisioned in the 2016 Business Plan's ridership and revenue forecasts.
Construction cost projection including estimates of cost escalation during construction and appropriate reserves for contingencies	The Funding Plan provides a summary level costs estimates for the Central Valley segment and references the 2016 Business Plan's Basis of Estimate document for the details of the methodology for the cost estimate.
A report describing any material changes from the plan submitted pursuant to subdivision (c) for this corridor or usable segment thereof	Funding Plan details material changes from the 2011 Funding Plan including the update to the Funding Plan's shift to reflect the 2016 Business Plan implementation plan, inclusion of Cap-and-Trade funds, updated environmental clearances and revised risk management reports
A description of the terms and conditions associated with any agreement proposed to be entered into by the Authority and any other party for the construction or operation of passenger train service along the corridor or usable segment thereof	Funding Plan includes summaries of key contracts for Construction Packages 1-4 and funding agreements for the Federal grants. Provides a high-level summary of the 2016 Business Plan's implantation strategy for the rail infrastructure elements to be procured.

Besides the information included in the Funding Plan itself, PFAL requested, received, and reviewed a variety of additional documents and pieces of information including, but not limited to, the technical specifications and details, schedule, current reporting, details of cooperative grant agreements, the Authority's plan to meet the requirements under those agreements, and more detailed elements of the cost estimates.

In a letter dated June 8, 2012, the Office of Legislative Counsel documented their review of the 2012 Business Plan for compliance with Prop 1A. This letter confirmed the implementation plan proposed by the Authority and reflected in the Funding Plan complies with Prop 1A. It further determined the Central Valley segment meets the requirements to qualify as a usable segment for Prop 1A funds. Section A of the Funding Plan further defines the usable segment and the construction elements included in the Funding Plan.

The civil works described in the Funding Plan (collectively referred to as Construction Package 1-4) has been under construction since 2013 and makes up approximately 40% of the total costs described in the Funding Plan. A substantial amount of work

has already been completed on the civil works portion described in the Funding Plan, providing a high level of design, specifications, cost and schedule data to evaluate. The remaining elements included in the Funding Plan are still under development by the Authority and will be procured at a later date. PFAL's review of the rail infrastructure components yet to be procured is based on preliminary specifications, estimates and assumptions under development by the Authority, or in some instances, conceptual plans. It is likely the final contracts and specifications will vary from the preliminary specifications provided to PFAL, which may change the conclusions in this report.

The clarification included in the September 2016 Assembly Bill ("AB") 1889 further enabled the Central Valley segment to qualify as a segment that is "**suitable and ready for high-speed train operation**." Though the Office of Legislative Counsel has determined that the Central Valley segment meets the requisite criteria for Prop 1A funds, it will not provide standalone high-speed rail operations until it is connected to the wider high-speed rail system. Therefore, we are unable to comment on whether the eventual planned high-speed rail operations to be provided by the Authority, or pursuant to its authority, will or will not require an operating subsidy under this Funding Plan.

Key Findings

The Funding Plan sets out to satisfy SHC 2704.08, subdivision (d) for the commitment of $2.609 billion of Prop 1A bond proceeds to be used as a source of funding for the Central Valley segment. The Funding Plan complies with the statutory requirements insofar as it addresses each of the SHC 2704.08(d)(2) criteria. Table 2 summarizes PFAL's independent opinion on each component of SHC 2704.08(d)(2).

Table 2: SCH 2704.08(d)(2) PFAL Summary Opinion

SHC 2704.08(d)(2) requirements	PFAL Opinion
Construction of the corridor or usable segment thereof can be completed as proposed in the plan submitted pursuant to the Funding Plan	The Central Valley segment can be constructed as proposed in the Funding Plan subject to the Authority implementing its planned risk mitigation strategies, project management enhancements and effective execution of proposed contracts; See Section 2
If so completed, the corridor or usable segment thereof would be suitable and ready for high-speed train operation	When completed, the Central Valley segment will be suitable and ready for high-speed train operation as stated in AB 1889; See Section 3
Upon completion, one or more passenger service providers can begin using the tracks or stations for passenger train service	Central Valley segment can facilitate passenger train service; See Section 4

SHC 2704.08(d)(2) requirements	PFAL Opinion
The planned passenger train service to be provided by the Authority, or pursuant to its authority, will not require an operating subsidy	The Authority does not contemplate passenger train service in this Funding Plan. Therefore, PFAL is unable to draw a conclusion regarding the potential requirement for an operating subsidy, see Section 5
An assessment of risk and the risk mitigation strategies proposed to be employed	Risks are identified and addressed by the Authority, see Section 6 for a risk summary

1. Funding Plan Overview

1.1 PFAL REVIEW APPROACH & METHODOLOGY

The Authority requested that the PFAL team perform a review of the Central Valley segment Funding Plan. PFAL initiated the review in conformance with SHC 2704.08(d)(2) on November 1, 2016 by requesting publicly available documents in support of the Funding Plan. These documents included, but were not limited to:

- California State bills
- Legislative opinions
- Authority business plans
- 2013 Project Risk Management Plan
- Peer Review Group review of work in progress on Risk Management
- Authority's 2015 Project Management Plan
- Construction Packages 1-4 contract documents
- Monthly status reports for each construction package
- Federal grant Cooperative Agreements
- Finance and Audit cash management and operations reports

The Funding Plan was not made available at that time, as it was still under review by Authority, but an overview was provided and there were numerous supporting documents relied upon in the Funding Plan that PFAL requested to verify the underlying assumptions and statements described by the Authority. After the initial review of these documents, PFAL and its subconsultants undertook an iterative process to pose questions and requests for clarification to the Authority with the Authority providing additional supporting information and clarifications as needed.

To facilitate the process, document and question requests were categorized by:

- Civil
- Electrification
- Capital Costs
- Construction Schedule
- Environmental
- Project Management
- Risk Management
- Operations
- Rolling Stock
- Legislation/Project Agreements
- Funding

The additional information requests included, but were not limited to:

- Authority's Track and System Specification
- General Provisions for the Track and Systems
- Integrated schedule
- Funding plan schedule by fiscal year
- Derivation of the contingency drawdown curve,
- Breakdown of costs for Funding Plan
- Basis of cost estimate for communications and signaling
- Third Party Agreements Report Summary
- Verification and Validation Management Plan
- Project & Construction Management Manual
- Updated Project Management Plan

The information was provided to PFAL by the Authority as it became available. As a result, the information requests were met at various stages of the review. As discussed in more detail in Section 6, the Authority made the determination that some confidential documentation related to the Authority's risk register was unable to be published or shared by the Authority. However, in response to PFAL's requests, the Authority walked PFAL through information that it deemed pertinent to allow PFAL to verify and confirm that the Authority had undertaken appropriate risk mitigation and/or that schedule and cost risks were appropriately addressed.

The project sources and uses funding plan was provided to PFAL by the Authority for the Central Valley Segment,

Following review of the provided documentation, PFAL and their subconsultants developed a register of questions to the Authority to seek explanation and clarification on a number of items. To expedite the process of clarifying open issues, PFAL and the Authority conducted two general funding plan meetings (one by teleconference and one in person) for PFAL to clarify open questions. The nature of the meetings was to facilitate the understanding of the Funding Plan in a factual manner that would aid PFAL's analysis and understanding. After the second meeting, it was determined a further teleconference specific to the Authority's technical standards was required (see Appendix II for summary notes).

A draft Funding Plan was provided to PFAL on November 14, 2016 and a second revised draft Funding Plan was provided to PFAL on November 29, 2016 by the Authority. PFAL then confirmed that the Funding Plan was consistent with the supporting documents previously reviewed.

Once the majority of supplemental information was provided and the draft Funding Plans were reviewed, the PFAL team and the Authority conducted teleconferences

on November 29, 2016 and again on December 2, 2016 to provide an opportunity for the Authority to clarify potential issues identified by PFAL. The purpose of these teleconference calls was to provide factual clarifications and respond to questions raised by the PFAL team regarding how the Authority identifies and manages risk and to clarify cost reporting with the Authority's Project Controls division. The outcomes of the teleconference calls have been incorporated into this Report.

The review of the documents and conversations as outlined above were limited to the scope of the Funding Plan for the purpose of this Report. PFAL's scope of work was limited to reviewing the content of the Funding Plan and its supporting documentation and information. **This means PFAL did not review procurement of high-speed trainsets or the infrastructure projects required to connect the Central Valley segment to the rest of the high-speed rail system because they are not included in the Funding Plan. Similarly, PFAL offers no opinion on projected Revenues for this segment nor Operations and Maintenance Costs because they are not included in the Funding Plan.**

To formulate an opinion on SHC 2704.08(d)(2), PFAL's Report is structured as set out in the following table.

Table 3: Report Structure

Report Section	Approach
Section 2	Analyzes the constructability of CP 1-4 and associated infrastructure elements included in the Funding Plan separately at first then in aggregate by determining the reasonableness of the following items to formulate an opinion on SHC 2704.08(d)(2)(a): • scope • procurement method • construction schedule • project management • project cost • funding • regulatory standings of the construction program
Section 3	Provides a review the Central Valley segment's ability to function as a foundation for HSR while providing near-term benefit to passenger rail service to formulate an opinion on SHC 2704.08(d)(2)(b).
Section 4	Evaluates the ability of the San Joaquins, or HSR, or both, to operate at prevailing speeds in the corridor to provide an opinion on SHC 2704.08(d)(2)(c).
Section 5	Addresses SHC 2704.08(d)(2)(d).
Section 6	Reviews the Authority's risk management plans for the Central Valley segment to form an opinion on SHC 2704.08(d)(2)(e).

1.2 PROPOSITION 1A FUNDING

In April 2012, the Authority published their 2012 Business Plan that outlined a phased implementation approach to reach high-speed rail operations. The phased implementation included early investments in the Central Valley segment that would later connect to what the 2012 Business Plan defined as the Initial Operating Segments ("IOS"). The IOS-North and IOS-South would ultimately be parts of the Phase 1 System, which would enables high-speed rail operations from San Francisco to Los Angeles and Anaheim[1]. The 2016 Business Plan describes the Authority's plan to start service on what is referred to the Silicon Valley to Central Valley Line ("Valley to Valley Line"), which is similar to the IOS-North from the 2012 Business Plan in the Funding Plan and 2016 Business Plan.

On June 8, 2012, the Office of Legislative Counsel provided an opinion that "the initial 130-mile (Central Valley) segment would qualify as a 'usable segment' under the (Prop 1A) bond act." The opinion was based on a number of factors, but most salient to this Report were:

- the Central Valley segment includes two planned stations at a minimum, and
- the completed Central Valley segment could be used by the San Joaquin passenger train service before providing high-speed rail service once the remaining segments of the HSR system are completed.

In July 2012, SB 1029 appropriated $2.609 billion of Prop 1A bond proceeds for the "Initial Operating Segment of the High-Speed Rail System". The Funding Plan addresses this $2.609 billion of Prop 1A bond proceeds appropriated by SB 1029, to help fund the Central Valley segment.

1.3 SUBJECT OF FUNDING PLAN

The usable segment as defined in the Funding Plan is the Central Valley segment. The geographical boundaries of the approximately 119 mile Central Valley segment is from the northern point in Construction Package ("CP") 1 near Madera Amtrak Station to the southern point in CP 4 near Poplar Avenue as seen in Figure 1.

[1] The IOS-North and IOS-South overlap in the Central Valley. The Central Valley Segment is the northmost segment of IOS-South and the southmost segment of IOS-North.

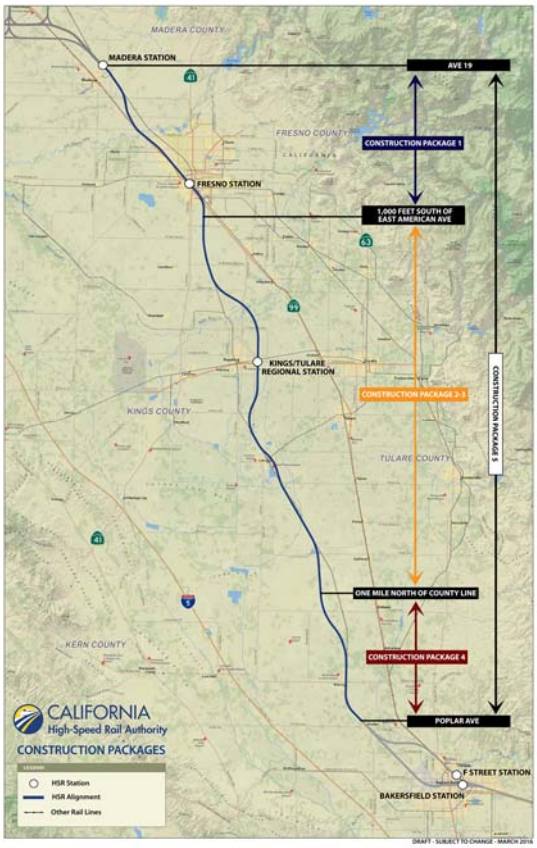

Figure 1: CP1-4 Map[2]

The Central Valley segment is predominantly a "greenfield"[3] project with the civil work currently under construction. The Central Valley segment will serve as a foundation for future high-speed rail operations once it is connected to the planned Valley to Valley Line. Prior to connecting to the Valley to Valley Line, the Authority will not operate stand-alone service on the Central Valley segment, but plans to eventually use it as a test track prior to high-speed train operations or for use by the San Joaquins.

The civil, track and system elements included in the Funding Plan are shown in Table 3. High-speed trains the Authority intends to procure are not included in this Funding Plan and are not subject to PFAL's review.

Table 4: Central Valley Segment Funding Plan Construction Elements

[2] Source: http://www.hsr.ca.gov/Programs/Construction/index.html

[3] A greenfield project typically refers to a project with no historic demand in the project location

Funding Plan Element	Scope	Procurement
CP1	• 32 mile stretch from Avenue 19 in Madera to East American Avenue in Fresno • 20 grade separations, 2 viaducts, 1 tunnel and river crossing	• Executed DB contract in August 2013
CP2-3	• 65 mile stretch from East American Avenue to north of Tulare-Kern County Line • 36 grade separations, viaducts, underpasses and overpasses	• Executed DB contract in June 2015
CP4	• 22 mile stretch from Tulare-Kern County Line to Poplar Ave. • construction of at-grade, retained fill and aerial sections of HSR alignment and relocation of four miles of BNSF track	• Executed DB contract in February 2016
Track	• All of the rails, fasteners, ties and interlockings required for the mainline, sidings and storage yards	• To be procured under one long term Track and Systems Provider contract
Railroad Infrastructure	• The additional infrastructure and any modifications to that provided under CPI to CP4 (or other civil contracts) required for the safe and efficient installation of the rail track	• To be procured under one long term Track and Systems Provider contract
Signaling and Communications System	• The technology and software required for the safe and efficient operations of passenger trains and maintenance rolling stock including positive train control requirements, the operations control center equipment and train/wayside communications	• To be procured under one long term Track and Systems Provider contract
Overhead Catenary System	• The electrical substations and overhead wiring required to enable the passenger trains to operate safely and efficiently	• To be procured under one long term Track and Systems Provider contract
Heavy Maintenance Facility	• The facility wherein the passenger trains are serviced and maintained	• To be procured as part of the Rolling Stock contract
Stations	• Locations where passengers can access and egress the passenger trains	• The Authority will provide the station buildings through a design-bid-build contracts. All station platforms are to be procured under one long term Rail Infrastructure Provider contract

The completion of the full scope of work proposed in the Funding Plan will provide a foundation for high-speed rail, but requires additional investments in high-speed trains (which is not included in this Funding Plan) to dynamically test, commission, and eventually run the planned high-speed rail operations. Before high-speed train passenger service can operate on the segment, the Authority plans to construct the Valley to Valley Line. These additional investments are not included in this Funding Plan or subject to PFAL's review under this Report.

Further description and analysis of the constructability of these Funding Plan elements is provided in Section 2 of this Report.

1.4 USE OF PROP 1A FUNDS

This Funding Plan pertains to the $2.609 billion of Prop 1A bond proceeds for the Central Valley segment as appropriated in SB 1029. A complete description of the sources and uses of funds for the Funding Plan is discussed in Section 2.6. As shown in the Authority's Central Valley Segment Sources & Uses Plan dated November 10, 2016 (based on the September 2016 Funding Contribution Plan) and summarized in Table 5, Prop 1A funds will be distributed starting in FY16-17 and fully expended by FY18-19.

Table 5: Central Valley Segment Use of Prop 1A Funds[4]

Fiscal Year (YOE $000')	Requested Amount	FY16-17	FY17-18	FY18-19
Prop 1A Yearly Expenditure		300,684	1,799,955	508,437
Balance	2,609,076	2,308,392	508,437	0

Prop 1A bond proceeds will fund various components of the Funding Plan scope of work, but will primarily fund site work, track and track structure. The uses of all funds including Prop 1A in the first three fiscal years is shown in Table 6.

[4] Central Valley Segment – Sources & Uses. California High-Speed Rail Authority. November 10, 2016.

Table 6: Central Valley Segment Uses of Funds in the First Three Years[5]

Fiscal Year (YOE $000')	FY16-17	FY17-18	FY18-19
Track	381,713	391,351	387,140
Stations	24,879	30,150	30,828
Support Facilities	0	32,635	32,185
Site work	370,140	670,232	577,957
Comms & Signaling	0	98,972	105,624
Electric Traction	0	49,721	150,701
Vehicles	0	0	0
Professional Services	297,102	433,662	254,175
Contingencies	0	272,075	454,037
Total	**1,073,834**	**1,978,798**	**1,992,647**

The above tables are indicative, and may change depending on demand given there are not yearly maximum or minimum thresholds set out by the Authority.

As outlined in Section D of the Funding Plan, Prop 1A bonds will be subject to a typical process for the sale of general obligation bonds. This includes the development of a biannual bond survey submitted to the Department of Finance. The Authority's cash flow projections are then submitted to the State Treasurer's Office through the Department of Finance to be included in the State's GO bond issuance.

[5] Central Valley Segment – Sources & Uses. California High-Speed Rail Authority. November 10, 2016.

2. Constructability

Having completed a review of all requested documentation, we have concluded that construction of the Central Valley segment can be completed as proposed in the Funding Plan, as specified, and in compliance with, environmental documents subject to the successful implementation of the planned risk mitigation strategies and project management enhancements.

The majority of the work in the Funding Plan is under contact in terms of contract value, and the Authority has expressed plans to implement more effective project management and controls based on lessons learned from CP 1 for CP 2-3 and CP 4.

The remaining elements of the Central Valley segment are yet to be procured and pose potential challenges with regard to integration, the availability of contractors, and the schedule for delivery. The schedule is aggressive and we believe it needs additional float to account for potential delays. Although this can delay completion of the project and any elements on the critical path, we believe that the segment can be constructed as proposed, but that will require active management and mitigation of schedule risks by the Authority. The budget contingency appears to be reasonable, but the Authority will have to actively manage the interface between the civil contract and track and system contract in order to avoid potentially significant change orders.

The Authority has a number of existing monitoring tools focused on the current construction work. As elements are added, PFAL believes additional reporting would be helpful and the Authority is prepared to institute such reporting through its PMIS and other tools that are being developed.

We consider the cost estimates for the Central Valley segment, including the allowances for contingency, to be adequate (although some individual line items appear a bit high or low from our standpoint, offsetting each other) and the funding to be sufficient to pay for those capital costs, even under a less favorable scenario than what the Authority assumes.

Our more detailed assessment on each of these items is provided below:

2.1 PROCUREMENT

2.1.1 CP1-4

The civil works for the Central Valley segment have been procured using Design-Build (“DB”) contracts denoted as Construction Packages (“CP”s). Three contracts have been executed:

- CP 1 – awarded 8/16/2013, with initial Notice to Proceed ("NTP") 10/15/2013[6]
- CP 2/3 – awarded 6/10/2015, with NTP 7/25/2015[7]
- CP 4 – awarded 2/29/2016, with NTP 4/15/2016[8]

CP 1 was awarded to the joint venture of Tutor Perini/Zachry/Parsons for $985.1 million, with other four other bidders' proposed prices ranging from $1,085 million to $1,537 million. CP 2-3 was awarded to the joint venture of Dragados/Flatiron/ Shimmik for $1,234.6 million, with two competing prices of $1,740 million and $2,066 million. CP 4 was awarded to California Rail Builders for $347.6 million, with three other responsive proposals ranging in price from $377.1 million to $581.9 million. The contracts were awarded through a competitive process that included extensive industry outreach. The Authority reported that the contract award amounts were below the engineer's estimate for each contract, and we view the awarded contracts as having favorable pricing. There is evidence the Authority is applying lessons learned from each CP contract to each subsequent CP contract.

Each of the DB contracts will be managed by a consultant Construction Management ("CM") firm. Contracts for Construction Management services were procured through a competitive process for each CP. The procedures and methods to be applied by the CM teams are documented in a Construction Management Manual.

In addition to civil works for High Speed Rail, implementation of the Central Valley segment requires relocation of a portion of State Route 99 ("SR 99") in the CP 1 segment of the project through an agreement between Caltrans and the Authority that was executed in February 2013[9]. A Construction Manager/General Contractor ("CM/GC") contract with Granite Construction is being managed to complete the relocation work. The Authority is funding this work through an interagency agreement in the amount of $225.9 million. The contract is divided into an early work package and a main package. The NTP for the main package was issued in August 2016. The November 2016 Finance and Audit Report for this project states that the interagency agreement will need to be amended to increase the budget and update the schedule,

[6] Monthly Status Report No. MR-038, Construction Package 1, Contract: HSR-13-06, CHSRA, November 2016
[7] Monthly Status Report No. MR-016, Construction Package 2-3, Contract: HSR 13-57, CHSRA, November 2016
[8] Monthly Status Report No. MR-3, Construction Package 4, Contract HSR 14-32 , CHSRA, November 2016
[9] Finance and Audit Report, State Route 99 Alignment, Contract HSR 12-06, CHSR, November 2016.

but the specific budget and schedule increases that are needed were not documented in this report.

As with any significant infrastructure project with more than one contract, interfaces among these civil works contracts and between the civil works and the follow-on rail infrastructure and the other elements of work must be effectively managed by the Authority to successfully deliver the Central Valley segment. These interfaces represent risks that could impact the cost and delivery schedule for the work, as discussed in Section 2.1.2. The Authority recognizes and is actively managing the interfaces and tracking the related risks in its program-level risk register.

2.1.2 Track and Systems Elements

The project delivery model chosen by the Authority uses a Track and Systems Contract ("TSC") to deliver, manage and maintain all the trackwork and the high-speed rail technology systems except for the passenger rolling stock. The TSC will also have major systems integration and very broad responsibilities which include[10]:

- Acting as the systems integrator for the rail infrastructure and the existing CP1 through CP4 civil works contracts as well as future civil works contracts that are needed to complete the high-speed rail network
- Acting as the systems integrator for the interfaces between the passenger rolling stock and the train control and communications systems
- Safely managing train operations using the operations control center technology that the TSC will supply (although this function may also be provided by the operator)
- Maintaining all the physical and technology rail infrastructure over a 30-year contract, and retaining operations and maintenance records for the HSR system
- Building station platforms
- Ensuring that the base civil works are "fit for purpose" and making corrections when appropriate

The TSC is at the center of the entire high-speed rail system and the scope and responsibilities are significant, although in line with how other HSR systems around the world have been successfully implemented, including in Taiwan (a system principally managed by the Authority's lead consultant, Parsons Brinckerhoff). The scope and risk also means that no single company is likely to have the physical,

[10] Section 7 of the Track and System Performance and Technical Requirements. California High-Speed Rail System. October 25, 2016.

intellectual or financial resources for the project. Accordingly, PFAL expects that large consortia will be formed to compete for the TSC.

The scope of work for the TSC includes both civil engineering construction and track and system supply elements. Currently, the Track and Systems Performance and Technical Specifications for the TSC are in the development stage and, as a result, are uneven in its detail. As part of the procurement process, the Authority needs to and will develop more details for the actual contract that will be entered into. PFAL understands that a more detailed the Track and Systems Performance and Technical Request for Proposal ("RFP") is being prepared for industry consultation, but was not available for our review. Therefore PFAL's review and ability to draw conclusions for this Report is limited to the current status of these document and does not reflect the final contract that will be executed from this procurement.

Section 7 of the Technical Specifications describes the scope of work for the various elements. There are some elements described where it is not clear from the description whether the TSC is required to supply, for example, the drainage system for the sections of the route constructed under CP 1 to CP 4. As the Authority develops the specification for procurement of the TSC, the Authority will need to (and plans to) clarify the scope of work for the TSC and scope of work to be provided by others.

Consistent with the industry-accepted DB model, the Authority has chosen the tone and tenor of those Specifications reflect an output rather than a prescriptive approach that places a higher burden on potential TSC competitors to fully define their approach during the bidding process. The use of output and performance based specifications reflects current best practices because this approach allows the contractor to propose the most cost effective designs and technologies. However, it is clear that the specifications need to be informed by a rail operating plan. PFAL understands the Authority plans to procure a railway operator, but recommends a railway operator be procured by the Authority as soon as possible to address this point to reduce the risks subsequently described. We understand the Authority is releasing an RFP for the Rail Operator in December 2016. We expect that the operator will be one that has experience with long distance intercity train operations on a commercial basis and experience in recruitment and training, designing and managing train timetabling, train control operation, terminal operations, safety management, degraded and emergency operations, commercial management and public relations management. Having a suitably experienced train operator on the project at this early stage will assist in the procurement and development of track and systems and will help to reduce risks to design and testing scheduling and implementation.

As the Central Valley segment construction proceeds, there will need to be more definitive information on the prospective TSC interfaces with the CP 1 through CP 4 civil works contracts – and how TSC contractors need to interface with those civil works contracts. For example, PFAL notes that the present civil contractors are making provision for OCS pole foundations at 30 ft spacing on aerial guideways. It is likely that the OCS designer will specify very high tensions in both the messenger and contact wire and it may be that additional supports are necessary particularly if mid-point anchors or terminating anchors are necessary. The Track and Systems Performance and Technical Requirements document is silent on the responsibility for providing any additional requirements, but we understand that the Track and Systems contractor may make use of this provision or provide alternative arrangements at its cost.

The Rail Infrastructure provider has a responsibility to coordinate with the train supplier to ensure the harmonic distortion at the point of common coupling with PG&E complies with the Energy TSI. It is unclear who has the responsibility for compliance and it is assumed to be the Authority.

The Track and Systems Performance and Technical Requirements document requires the contractor to undertake modeling of the traction supply arrangements taking into account the track alignment, gradient, proposed trains and service patterns. However, the only guidance in the document is that the system shall achieve the headway. We understand that the Authority has completed representative modeling work that it believes will provide for satisfactory feeding arrangements, but in the absence of an operator, service timetable and actual train design there is a risk that modelling work will be delayed and that the proposed feeding arrangements may not be adequate for full service. PFAL understands that the Authority has completed representative modeling using a service plan that has 9 double headed trains and 3 single headed trains operating continuously at 5 minute headways which is very conservative. The traction power characteristics of a modern representative high-speed trainset (AGV) has been used (and has been benchmarked against the trainsets offered by established high-speed trainset providers such as Siemens, Kawasaki, Bombardier and CRRC. We would expect that such information will be provided, as guidance, for the TSC contractor.

Finally, this will rank among the world's largest railway systems contracts and comes at a time when the five or six major contractors are all busy with other projects and opportunities. This means that there may be intense competition for experienced professional technical resources with consequential labor inflation - perhaps coupled with schedule delays as productivity should adjust to match available resources. The Track and Systems Performance and Technical Specifications require the TSC to undertake training programs to mitigate these labor concerns, but there are steps that

the Authority can take now to mitigate these risks. The Authority needs to consider stepping up outreach to California universities and colleges to foster courses in railway technology, maintenance and operations to build a larger labor pool that can be ready when required to support the high-speed rail program.

The PFAL team has reviewed some of the key contract terms and conditions and the processes and procedures being used by the Authority to procure the TSC. Those procedures can be effective. Our concern is that, given the complexity, scope and interfaces in the contract - and the availability of experienced resources - there are many opportunities for contractors to exploit the interface risks which could result in schedule delays and cost increases during a 30-year service period contractual relationship with a contractor whose contract scope will necessarily expand. This issue would be found on any contract of this magnitude and duration. Again, the Authority will require knowledgeable and experienced resources to oversee and manage those interfaces, notwithstanding the fact that they are contractually the responsibility of the TSC.

Although the Track and Systems contract will be a major infrastructure procurement that will require the Authority to further develop its procurement and management approach, we believe that the Authority is taking the necessary steps to do that. We see no technical issues that would prevent successful delivery of the Track and Systems contract and as long as the Authority stays on its current path, we believe that the infrastructure can be built as described in the Funding Plan.

2.2 SCHEDULE

2.2.1 CP1-4

The schedule for the awarded construction packages is summarized in the Authority's CHSR Program Summary, Central Valley[11]. The construction work associated with the NTPs in each contract (CP 1 has three separate NTPs) is represented by a single activity in this high-level schedule. At the very high level of detail presented in this schedule, no logic ties to the right-of-way acquisition work that must precede construction are shown. The review of this schedule was unable to confirm that these ties are included in the detailed critical path schedule that is being used to monitor and control the program. Such logic ties are best practices for effective schedule reporting and forecasting, as delays in the completion of property acquisition have been the primary reason for a 17-month extension to the completion

[11] Summ2 TILOS FCS.pdf, data date 9/1/2016.

date for CP 1. While we did not review the detailed workplans, the Authority's project controls team explained that they maintain workplans for each project that include logic ties for right-of-way acquisition and other critical path activities.

The timescale for the Program Summary schedule provided for this review is presented in years from an arbitrarily selected start time. The Authority presented a time and location scaled summary to the review team that was based on calendar dates. For effective tracking and control, all schedule presentations should use a timescale based on actual dates for easy assessment of the current status of the work.

The end dates for the active construction packages presented in the Program Summary appear to match the completion dates required in each of the contracts as reported in the November 2016 Finance and Audit Committee Monthly Status Reports (MSR):

- CP 1: 8/31/2019
- CP 2/3: 8/19/2019
- CP 4: 6/3/2019

The completion date for the realignment of SR99 by Caltrans is shown in late 2018, whereas the MSR for this project indicates a contract completion date of 6/30/2018. The MSR indicates that the existing agreement with Caltrans will need to be modified to extend the completion date, so the Program Summary may reflect the planned extension.

The baseline Program Summary does not include any schedule float for the CP 1-4 construction work. Logic ties to the Rail Infrastructure work that will follow these contracts are not indicated in the Program Summary, but the Authority has indicated that there is one to three months of float between the civil works contract completion dates and the start of construction for the Rail Infrastructure contract. The FTA's recommended scheduling practice[12] calls for schedule float equal to 25% of the remaining duration of project work be included in the projected completion date, and the current schedule float does not meet this recommendation. The planned schedule float could be "allocated" to individual work packages or included at the end of the schedule as combined program schedule float. Applying the FTA-recommended practice for the CP 1-4 construction work yields an overall completion

[12] Oversight Procedure 40b, Risk and Contingency Review (Abbreviated), Federal Transit Administration, September 2015

date of May 2020, about 250 calendar days later than the date indicated in the Program Summary, far more than the three months that is said to be available in the current program schedule.

Inclusion of a reasonable schedule float, as referenced above, in the Program Summary schedule is advisable, as the Authority has been challenged to control the schedule for CP 1 and has indicated that there is a risk of further schedule delays due to delayed right-of-way acquisition[13]. A further indicator of the potential for delayed completion of the civil construction work is the projection of earned value for CP 2/3 in the November Finance and Audit Committee Operations Report[14], which indicates that the cumulative earned value achieved in September 2017 will be only 67% of the planned value. The Authority has indicated work in CP 2-3 is on the critical path for completion of the Central Valley segment and the lower than planned earned value suggests that delays are likely. Given the potential risk, the impact of schedule delays pose to the Track and Systems work, the Authority indicated that the schedule for the Track and Systems work could be accelerated through a variety of strategies, including having multiple trackwork installation headways. Additionally, since the Track and Systems contract has not been procured, that Track and System contract's timeframe may be possible to adjust or resequence the contract timeframe to mitigate reasonable delays in the delivery of CP1-4 at this point with no cost impact besides escalation. However, this could delay other follow-on work accordingly.

The original completion date for CP 1 was March 21, 2018. The start of construction was delayed due to late completion of right-of-way acquisition by the Authority. The completion date in the CP 1 contract is now August 31, 2019, representing an extension of 17 months or 32% of the originally planned duration. This delay indicates insufficient planning of work to support the construction contract and inadequate schedule forecasting and control capabilities during the procurement of CP 1. Had sufficient schedule management resources and procedures been in place, the inadequate progress of right-of-way procurement would have been identified and either additional resources assigned or the CP 1 NTP delayed to avoid the significant delay and acceleration costs that have accrued.

We recommend that the Authority confirm that its master schedule includes sufficient logic ties between the active construction packages and the follow-on contracts to

[13] "Parcel acquisition is behind the dates specified in the Right-of-Way Acquisition Plan and continues to be a schedule risk.", Finance and Audit Committee Monthly Status Report, CP 1, Data Date 9/30/2016, CHSRA, November 2016.
[14] F&A Committee Operations Report, CHSRA, November 2016, page 72.

represent the possible impacts of further delays to CP 1-4. Furthermore, we recommend that the Authority use the results of its risk-informed contingency analysis (which includes an assessment of possible risk-related schedule delays) to produce risk-informed schedule forecasts. The Authority stated that it currently does not consider the potential schedule delays identified in the CP1-4 risk assessments to affect the available schedule float in the program schedule or to project likely program completion dates. The Authority further states that it intends to incorporate the CP 1-4 risk assessment results in its program schedule evaluation process after it completes the detailed contract level risk assessment and Monte Carlo modeling for the Rail Infrastructure contract. The Authority is encouraged to begin evaluating the impacts of likely delays to CP 1-4 on the Rail Infrastructure construction start date and the overall Central Valley segment completion now, rather than waiting for the Rail Infrastructure risk assessment to be completed.

The Authority has stated that enhanced program controls, including schedule forecasting and management are under development. As part of this effort, the Authority should develop and maintain a critical path schedule showing the current and future activities that need to stay on-track to achieve the forecasts project completion date. Routine monthly reports to decision-making bodies should include the status of the critical path work and identify mitigation strategies to recover from any delays.

2.2.2 Track and Systems Elements

The Authority has conducted extensive industry outreach on the Track and Systems. In addition to the one-on-one meetings arising from the formal RFEI process, the Authority has also held numerous one-on-one meetings with parties expressing interest in participating in the Track and Systems work – this has included those that could lead a JV, be part of the JV or to provide specialist support to the JV and included the major technology providers and large scale program management companies. While this is a good start, in our experience the complexity of the Track and Systems Performance and Technical Specifications, the broad responsibilities of the TSC and the 30-year contract term are likely to lead to a longer bidding cycle than the times given in the current schedule. The formation of consortia to address this contract will take a long time, both in terms of assembling the right team capabilities, but also in terms of obtaining the appropriate governance arrangements to manage the consortia. This means that the Authority should expect a lot of legal dialog, both within the consortia and with the Authority. That will take time that is not fully contemplated in the schedule. Furthermore, given the scope and complexity of the contract, even after a contract consortium is selected, it will take a long time to negotiate final terms, conditions, scope, indemnities and payment schedule. We

would expect that such negotiations will be akin to those of a full public private partnership ("P3) and could take as long as 12 months to bring to closure[15].

The PFAL team expects the risk of schedule overruns is more likely for the Track and Systems elements of the project than for the civil works elements. Experience of large projects of this type suggest that the schedule could overrun by as much as two years[16,17]. The Authority reported that there is a small amount of float in the current schedule (one to three months). This is likely to be absorbed during the procurement phase in the project. It will be necessary to re-examine the baseline schedule during the negotiations with the TSC to reduce the risk of further delays to the schedule. In our view, the Authority's schedule seems to be aggressive in that it ties directly to contract completion dates and does not allow for sufficient slack to account for potential contract delays. The TSC procurement may also require additional time. Although delivering the entire scope of work according to this schedule is feasible, we consider it challenging and would encourage the Authority to take active steps to manage and mitigate any schedule delays. We do not believe that schedule delays would have a significant impact on the Authority's overall ability to deliver the scope that is included in the Funding Plan.

2.3 PROJECT MANAGEMENT

2.3.1 CP1-4

The latest finalized and approved version of the Program Management Plan ("PMP") for the high-speed rail program[18] does not reflect the 2016 Business Plan or the Central Valley Funding Plan. The Authority has stated that an update of the PMP is underway and that publication of the revised document is expected after the Funding Plan is finalized. The updated PMP will reflect the 2016 Business Plan, the Central Valley Segment Funding Plan, the current integrated Program Delivery organization, an updated Program Controls Plan, along with updates to the supporting functional information necessary to deliver the 2016 Business Plan and Central Valley Segment Funding Plan. Current project management documents are crucial to the effective

[15] For example on the Gautrain contract which was similar in complexity it took 16 months after contract award to resolve commercial and technical issues related to operation requirements, interfaces, O&M payments, contractor changes that required environmental approval. etc
[16] London Underground Sub Surface Re-Signaling. RailEngineer. October 15, 2015.
[17] Moreton Bay Rail Link Will Not Open on Schedule Due to Signaling Faults. ABC. May 16, 2016.
[18] Program Management Plan, 2015 Annual Update Revised, California High Speed Rail Program, CHSRA, September 2015.

monitoring and control of major projects and programs and the Authority is encouraged to expeditiously complete its update of the PMP.

The PMP is a high-level document that addresses the overall high-speed rail program without details regarding the planned approach to managing specific projects within the program. The PMP includes references to appropriate supporting documents, including Quality, Safety and Security, and Risk management procedures. The Program Controls system is described as under development.

The review identified a need for more consolidated monitoring of the overall status of the cost and budget for the Central Valley segment. The Authority uses a combination of reports prepared each month and submitted to the Finance and Audit Committee to monitor progress against budget. The reports include the Capital Outlay, which provides Budget, Expenditure and current Project Forecast data for each active and planned work package; and the CP Monthly Status reports which provide additional detail on the original contract price and completion date and executed change orders for active construction contracts.

The review identified issues with the consistency or traceability of reported budget and cost information among the various reports that should be addressed in developing consolidated monitoring and control procedures for the Central Valley segment as a defined project. For example, the November 2016 Capital Outlay report indicates a single contingency amount of $89.1 million for all of the work in CP 1 (DB contract work, SR99 relocation by Caltrans, construction management services, right-of-way and third party contract work reimbursed by the Authority). The Authority acknowledged that additional contingency is included in the budgets for SR99 and the third party contracts that is not identified as separate line items in the report. It is strongly recommended that all contingencies be specifically identified and tracked over the life of the project to increase the likelihood of on-budget completion of all of project work.

Existing monitoring reports cover the individual work packages that are under construction and identified for procurement, but do not provide sufficient monitoring information for the combined cost performance of these work packages. Additionally, the work elements currently reported correspond to the work scope currently approved construction contracts, not the exact scope of the Funding Plan. The rest of the cost is at the estimate level and the Authority described its plans to add those other pieces into future reporting after approval of the Funding Plan and release of the other contracts for bid. It is recommended that the Authority adopt a monitoring and reporting process consistent with current practice that addresses the complete work scope for the Central Valley funding plan. The monitoring reports should include forward looking information, including pending contract changes and issues

(commonly referred to as trends) to project the cost of each work package and the full program at completion. Cost contingencies embedded in the estimates for all work elements should be explicitly reported. At present the only cost contingencies identified are for the active construction packages.

The Authority stated that the updated PMP will include a Program Controls Plan that includes the more detailed level of reporting and industry standard processes, terminology and indicators such as those recommended by this review. In addition, the Authority is developing a PMIS system to provide real-time access to the project status information. The Authority further noted that when the Funding Plan is approved, the approved budgets will be included in the Total Program Construction section of the Capital Outlay and Expenditure Report and as contracts are awarded, the contracts will be tracked in Monthly Status Reporting and in the PMIS. These improvements to the project controls procedures should enhance the Authority's ability to control both cost and schedule for the Central Valley segment.

Cost control has been a challenge for the Authority on CP 1, primarily due to delays in securing necessary right-of-way for the start of construction. The budget for CP 1 has increased by $303 million, or 26% to reflect an increased scope due to the extension of the work to Madera and the addition of extensive unanticipated utility coordination and relocation work. A further change order of $13.6 million to cover contractor costs for accelerating work is anticipated. The cost reports provided to the Finance and Audit Committee on a monthly basis include a summary line item for change orders that aggregates cost changes due to schedule delays, expanded geographic scope and added utility work. The Authority has stated that it has increased resources and improved procedures for right-of-way acquisition, and the Authority's latest risk information indicates that the cost and schedule impacts of any further delays in right of way acquisition to CP 1 should be minor.

Although the delays in right-of-way acquisition and the continuing risk of further delays highlight a need for better agency resource planning and schedule control, the Authority is implementing mitigation measures from the lessons incurred in CP1. These issues are discussed in Section 2.2.

The Authority's current management systems and planned enhancements are adequate to monitor and control the delivery of the scope of the Central Valley segment. Additional management reporting will need to be provided to address the full scope of work and the Authority appears to be planning to develop an industry standard project reporting capability with its plans for a PMIS and updates to the PMP.

2.4 REGULATORY STANDING

The regulatory and environmental review focused on the FEIR / FEIS documents, applicable records of decision ("RODs"), and on review of the design build contracts and associated documentation describing the projects and the design builders' progress. The focus is on the Central Valley sections of the project (CP 1, CP 2-3, and CP 4).

The FEIR / FEIS for the Merced to Fresno Central Valley section was published in 2012. The Federal Railroad Administration issued its ROD on September 18, 2012. The ROD selected the "Hybrid Alternative, Merced Downtown Station, and Fresno Mariposa Street Station" for the Project because the hybrid (1) "best [satisfies] the Purpose, Need, and Objectives" and (2) minimizes "impacts on the natural and human environment by utilizing an existing transportation corridor where practicable and incorporating other mitigation measures."[19]

The FEIR / FEIS for the Fresno to Bakersfield section was published in April 2014. The Federal Railroad Administration issued its ROD on June 27, 2014. The FRA via the ROD selected "portions of the BNSF Alternative with the Corcoran Bypass, Allensworth Bypass, and Bakersfield Hybrid alternatives." The Project also includes "the Kings / Tulare regional Station – East Alternative and the Downtown Bakersfield Hybrid Station Alternative." FRA did not select a Heavy Maintenance Facility alternative at the time of the ROD. The ROD states that these alternatives (1) "best satisfy the Purpose, Need, and Objectives" and (2) "minimize impacts on the natural and human environment by utilizing an existing transportation corridor where practicable and incorporating other mitigation measures."[20]

The ROD, thus, imposes specific environmental and regulatory requirements on the Authority and the three design / build contractors.

The Authority, in turn, assumed specific responsibilities based on the ROD and its associated documents when it entered into a design build agreement for CP 1, CP 2-3, and CP 4. These responsibilities, spelled out in the Special Provisions, included:

- For CP 1, per Part A.2, section 2, tiered Notices to Proceed that defined the completion deadlines (NTP 1, 2, and 3) allowed for escalation according to a specified formula and an allowance after 360 days for a negotiated change order

[19] FRA ROD, p.41
[20] FRA ROD, p.43

and time adjustment that accounted for environmental, regulatory, and other requirements and contingencies.

- For CP 2-3 and CP 4, per Special Provisions 2.0 and 3.0, Notices to Proceed that, in turn, defined completion deadlines were specified, allowing for escalation according to a specified formula, as well as an allowance after 360 days for a negotiated change order and time adjustment that accounted for environmental, regulatory, and other requirements and contingencies.
- Substantial Completion for CP 1 was set at 51.5 months after NTP-1 with the Final Acceptance Deadline defined as 53.5 months after NTP-1. CP 2/3 allowed 980 days after NTP for substantial completion and 1025 days for Final Acceptance. CP 4 allowed 740 days after NTP for substantial completion and 785 days for Final Acceptance.
- Contract CP 1 was signed with the Merced to Fresno section environmental documents already complete and covered by the FRA's Record of Decision (ROD) and other decision documents referenced in section 8.1. CP 2/3 and CP 4 were also tied to the Fresno to Bakersfield FEIR / EIS and its FRA Record of Decision of June 2014.
- All three design build contracts (in their Special Provisions) include specific allocations of responsibility for obtaining government approvals. Per these Special Provisions, the Authority committed to beginning "to implement all off site mitigation measures … as necessary to allow impacts to resources subject to … Governmental Approvals to proceed in compliance with applicable Laws." [quote extracted from Special Provision 6.1.1 for CP 2/3, with similar language included in CP 1 and CP 4]
- CP 2-3 and CP 4 included a specific reference to the Authority's Environmental Mitigation Management and Assessment ("EMMA") database to document compliance with all Environmental Requirements. The Authority required the CP 1 contractor, post-contract execution but consistent with the terms of the contract, to use EMMA. All three contracts include reference and required compliance with the Mitigation Monitoring and Enforcement Plan ("MMEP").
- The Authority's CP 1, CP 2-3, and CP 4 agreements appear to have addressed the environmental and regulatory requirements in an inclusive manner that links contractor requirements and the Authority's own requirements. The risks associated with achieving the commitments appear to be normal project risks that can be managed by EMMA and MMEP. Future contracts (after CP 4) should carry references to both EMMA and MMEP.

However, the Authority's obligations to obtain approvals and permits on a specific time frame imposes performance, cost, and schedule risks. Because CP 1 was the earliest contract, the Authority's exposure to cost and schedule risks were the greatest in relation to this contractor. The impact of those risks may have been eclipsed by the impact of right of way and third party agreements after CP 1 started work. Nonetheless, the schedule impacts may have contributed to the overall delay and extension of the CP 1 contractor's work (currently shown as approximately 1,690 days on the current CHSR Program Summary Schedule (CHSR Schedule) versus the original 1,115 days / 51.5 months in the CP 1 contract. CP 2-3 and CP 4 appear

to have avoided the schedule impacts that affected CP 1 and show projected completion dates in line with their original durations in the CHSR Schedule. As a mitigation measure, the Authority should follow the model used in CP 4 that provides a more complete set of references to EMMA and to MMEP for future contracts. Additionally, schedule provisions for future contractors should continue to include adequate time allowances for the Authority's efforts to meet environmental and regulatory commitments.

The Heavy Maintenance Facility ("HMF") was addressed in both FEIR / EISs for the Central Valley. However, the HMF was not included in the ROD. The future contract that will include the HMF should include any additional or new environmental commitments that may be imposed via a future FRA ROD or by CEQA.

The Authority's environmental documents included obligations that it and its contractors comply with. However, these obligations appear to be well managed and none of the obligations would appear to pose any serious issues for the Central Valley segment to be built as planned.

2.5 CONSTRUCTION COST

2.5.1 CP1-4

The total budgeted construction cost for the civil works for the Central Valley segment is $5,329,359,278. Of this amount, $3,214,467,635 or 60% is for the executed construction contracts not including remaining construction contingency. The remaining $2.1 billion in budgeted costs included right-of-way acquisition, construction management, and work by third parties, including $260.9 million for the realignment of SR99 by Caltrans. The budgeted cost also includes $512.5 million in approved contingency for the construction contracts, based on the November Capital Outlay Report. The reported remaining contingency represents approximately 16 % of the total DB contract amount.

Expenditures to date for the DB construction work as of the November 2016 Capital Outlay Report totaled $654,811,250 or 21% of the contract amount. The remaining contract amount to complete the civil works was $2,451,882,908. An important indicator of budget sufficiency is the available contingency as a percentage of the remaining work. The $512.5 million in apparent available contingency represents 21% of the remaining contract amount, which is above the industry-standard 10% for work that is under construction. The identified contingency is only related to the construction contract work. The Authority has indicated that additional contingency is embedded in the other budget line items (such as third Party Contract Work), which provides an additional level of confidence that the civil works can be completed within the identified budget. The Authority should explicitly identify and track all contingency amounts as part of its project controls process.

The Authority includes cost contingency draw-down curves for the active construction contracts in its Finance and Audit Committee Monthly Operations Report. The November 2016 reports indicate potential contingency shortfalls of up to $19 million for CP 1 and up to $8 million for CP 2-3. These relatively small contingency shortfalls, if realized, could be accommodated by the $276 million in unallocated contingency included in the overall budget for the currently planned construction work. The Authority reported that it intends to conduct an updated risk assessment and contingency evaluation for CP 1 following the execution of major contract change orders and updates to the CP 1 budget. It appears that there should be sufficient contingency, either in the allocated amounts for the construction work, or the unallocated contingency to accommodate any adjustments that are likely to be needed.

2.5.2 Track and Systems Elements

It is noted that in the 2016 Business Plan Basis of Estimate, it is stated that sources for bid prices have come from local, regional, statewide and national levels, as well as from international high-speed rail projects. It also states that prices were verified by looking at active projects in the state and that these were documented and adjusted for site, escalation or location factors.

The Funding Plan provides the following budget line items:

Table 7: Central Valley Segment Budget

Capital Costs	Cost to Complete (2015 $)	(YOE$)	Expected Through FY 15-16	Total Capital Costs
Track structures and track	1,228	1,305	202	1,507
Stations, Terminals, Intermodal	137	145	4	148
Support facilities, yards, shops, admin buildings	106	118	0	118
Site work, right of way, land, existing improvements	1619	1750	798	2,549
Communications and signaling	292	309	0	309
Electric traction	512	540	0	540
Vehicles	0	0	0	0
Professional services	1.191	1,289	431	1,720
Sub-total	5,087	5,456	1,434	6,890
Total contingency	**874**	**923**	**0**	**923**

Note: Totals may not sum due to rounding.

Benchmarking comparisons for new high-speed railway projects are very difficult to evaluate since not all agencies report costs or estimates in the same way. In many instances, internal costs are excluded and in some cases, civil engineering costs are regarded as construction costs and systems are treated separately. However, a survey by the World Bank[21] suggests that the costs for the Central Valley segment are high in comparison with European and Chinese high-speed rail projects. This may provide a certain degree of comfort in this review but only in respect of declared costs. In comparison with UK high-speed rail system costs, the Central Valley segment cost is low. This may be explained by the fact that most UK projects are driven by "brownfield" costs whereas the Central Valley segment is predominantly a "greenfield" project.

So, we find that the budget allocated to the Track and Systems portion of the project Central Valley segment is sufficient. However, we also find that the budget allocated to Signals and Communications line item in particular may be low for an ERTMS level 2 type of system design. PFAL was provided a detailed line item budget breakdown for the Signaling and communications system, dated December 1, 2016. The Signaling and Communications line item budget also has a category for the train control system that will be required on-board the passenger trains. However, no funding was allocated to this on-board system within the Signaling and Communications budget with the expectation that such a system will be supplied by the rolling stock provider. In the interests of effectively managing major technology interfaces, PFAL suggests that the Authority consider procuring the on-board systems as part of the Signaling and Communications package and then providing that system as "free issue" to the rolling stock provider for installation on the passenger trains.

The level of estimating detail for Signals and Communications provided to PFAL is parametric in nature. However, cost comparisons with other ERTMS projects are clouded by "brownfield" and "greenfield" considerations. We would expect that the Signals and Communications budget should be more in the order of $500 million (2015$). Accordingly, PFAL suggests that the Authority maintain a critical review of the line item budgets within the Track and Systems overall budget - and stay within that overall budget which PFAL considers achievable. PFAL believes that the total cost estimate for the Central Valley segment is adequate to deliver the Track and Systems scope of work for the Central Valley Segment.

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[21] Gerald Ollivier, Jitendra Sondhi, and Nanyan Zhou, *High-Speed Railways in China: A Look at Construction Costs*, report no. 89200, July 2014.

2.6 CENTRAL VALLEY SEGMENT FUNDING

The analysis of the Central Valley segment funding sources is important to demonstrate sufficient funding is available to meet the proposed construction schedule. The Funding Plan includes $7,813.26 million for the Central Valley segment as seen in Table 8. The Central Valley segment will be funded through three sources: Prop 1A , Federal grants, and State Cap-and-Trade proceeds.

Table 8: Central Valley Funding Sources

Sources	(YOE $ million)
Prop 1A	2,609
Federal	2,970
Cap-and-Trade	2,234
Total	**7,813**

2.6.1 Federal

Total Federal funding for the Central Valley segment is $2,969.80 million. The total Federal funding is comprised of two separate sources as shown in Table 9: the American Recovery and Reinvestment Act Grant as amended in May 2016 ("ARRA") between the FRA and Authority[22]; and the FY 2010 Cooperative Agreement between the FRA and Authority ("FY 2010")[23].

Table 9: Federal Grants for Central Valley Segment

Federal Funding	(YOE $ million)
ARRA	2,041.18
FY 2010	928.62
Total	**2,969.80**

Total Federal assistance under ARRA is $2,552.0 million, but only $2,041.2 million will be used in relation to the Funding Plan. To date, over 60% of the Funding Plan's

[22] California High-Speed Train Program ARRA Grant (FR-HSR-0009-10-01-06). FRA. 2016.

[23] Initial Central Valley Section: Madera County to Bakersfield (Kern County) of the California High-Speed Train Program (FR-HSR-0118-12-01-00). FRA. 2011.

ARRA funds are expended with the remaining portion to be expended in FY 16-17. According to the Authority, ARRA funds will be fully expended around Spring/Summer 2017, which is in compliance with the ARRA funding period end date of September 30, 2017. The ARRA Cooperative Agreement further sets a performance period end date of December 31, 2022. PFAL reviewed the Scope of Work in the ARRA Cooperative Agreement, as it pertains to the elements included in the Funding Plan, and found it is in compliance with the Funding Plan's schedule. Further discussion on the reasonableness of the Funding Plan schedule can be found in Section 2.2. Matching contribution requirements for the Authority to stay in compliance with the ARRA Cooperative Agreement are set out in the Funding Contribution Plan for period end June 30, 2016 and updated on August 31, 2016[24].

As required in the ARRA Cooperative Agreement, and reflected in the Central Valley segment Sources & Uses table, all ARRA funds will be expended before the Funding Plan utilizes the $928.6 million of FY 2010 funds. FY 2010 funds will be expended from FY 18–19 through FY 20-21. These funds are appropriated and agreed to fund the Central Valley segment.

2.6.2 Cap-and-Trade

The Funding Plan includes $2,234 million in Cap-and-Trade proceeds, roughly 29% of the total Central Valley segment funding, starting in FY 16-17 through FY 22-23. We understand that the Cap-and-Trade funding amounts and timings were provided to the Authority by the Air Resources Board ("ARB"). The ARB funding estimates and the methodology for their development was not provided to PFAL for review.

A majority of this source of funds is still required to be acquired through quarterly State Cap-and-Trade auctions. The Authority is assuming, based on ARB information, that it will receive $500 million per year from Cap-and-Trade proceeds[25] for this Funding Plan and other anticipated funding needs for the Phase 1 system.

The quarterly Cap-and-Trade auction has insufficient historical information or comparable benchmarks that would allow us to independently verify the Authority's Cap-and-Trade planning assumption. Despite this, PFAL made best efforts to analyze the reasonableness of the Funding Plan's use of Cap-and-Trade proceeds given the recent volatility in Cap-and-Trade auction results.

[24] Funding Contribution Plan (FCP). California High-Speed Rail Authority. August 31, 2016.

[25] Cap-and-Trade proceed budget based on California Air Resources Board

The high-level analysis of the Funding Plan's Cap-and-Trade use is based on the assumption that these funds will be used on a pay-go basis (as indicated in the Funding Plan), Cap-and-Trade funds will be spent according to the Central Valley segment Sources and Uses schedule dated November 10, 2016 (though funding can be distributed on an as needed basis per year), and makes no assumptions for committed or planed Cap-and-Trade expenditures outside of this Funding Plan. This analysis is considered to be indicative of the level of Cap-and-Trade proceeds in potential scenarios given the limited time, scope and information available for this Report.

The large Cap-and-Trade expenditure in FY 18-19 and the fact Cap-and-Trade funds will be expended on a pay-go basis requires reserving to meet the FY 18-19 demand. Besides the Authority's baseline scenario, PFAL looked at an additional scenario to determine the potential Cap-and-Trade reserving required. PFAL assumed the cash balance of $874 million as reported in the Funding Plan. The first four years would require the Authority to receive a minimum of approximately $202 million Cap-and-Trade proceeds to sufficiently reserve for the projected Cap-and-Trade expenses.

Table 10: Potential Cap-and-Trade Proceeds Required Assuming Cash Balance as of December 2016

	FY15-16	FY16-17	FY17-18	FY18-19	FY19-20	FY20-21	FY21-22	FY22-23
C&T Proceeds		202,088	202,088	202,088	202,088	210,482	109,922	90,285
C&T Expenditures		24,879	178,843	1,069,996	408,634	210,482	109,922	90,285
C&T End Balance	874,000	1,051,209	1,074,454	206,546	-	-	-	-

In summary, we have not had access to the methodology behind the original ARB estimates for Cap-and-Trade proceeds, so we offer no opinion on the reasonableness of their forecasts. However, we do have confidence that Cap-and-Trade proceeds will be made available to the Authority to support this Funding Plan and that the Authority will use these funds to build their funding reserves as indicated in the Funding Plan.

It is outside the scope of this Funding Plan to evaluate the feasibility of Cap-and-Trade proceeds to fund other elements of the Phase 1 system. However the $500 million per year projection will require additional scrutiny in subsequent funding plans due to the volatility seen in recent auctions, the ongoing court case regarding the

legality of state-auction allowances, and the uncertainty regarding the Air Resource Board's authority to continue Cap-and-Trade past 2020.[26]

2.7 DESIGN

Design and construction documents included within the Construction Packages CP 1, CP 2-3 and CP 4 were reviewed to identify issues that could impact cost and schedule requirements indicated within the Funding Plan. Design Criteria, Specifications, Directive Drawings, Guidelines, 15% Preliminary Design Plans, Composite Utility Plans, Design Reports, and other relevant documentation were reviewed as part of the analysis to develop findings. Engineering judgment and past experience from major transportation projects and programs of projects were used as a barometer of Authority design progress and status to date. Although the management of the following findings is considered critical to project success, no fatal design flaws have been identified based on the information that was available and reviewed. The project is still in the early phase of implementation and can be delivered successfully within the budget and schedule requirements identified in the Funding Plan.

Preliminary Engineering designs were developed by the Authority's consultants during the environmental review stage, that establish project footprint including typical sections, alignment plan and profile, roadways and grade separations, preliminary structure layouts and elevations, and major utility relocations among other project features. Based on past experience and to minimize risk, design-build contract documents are typically developed close to a 30% level of completion. As a result, potential conflicts and other design issues cannot be fully evaluated with this review or by the Authority at this time. The risk assessment conducted by the Authority has captured and adequately addressed various risks related to geotechnical, utilities, hazardous materials and other less developed design components and budget contingencies have been allocated. If the Authority manages risks and the risk process is carried out as described, completing the project in accordance with the Funding Plan is possible.

Stations designs or typical sections, from PFAL's review, were not provided with CP 1 through CP 4 Civil Contract package and cannot be evaluated for potential design issues at this time. The Authority reports that station design will be conducted under a separate design-bid-build project delivery method with the platform construction advertised for construction through the systems related design and construction

[26] Legislative Analyst's Office. December 1, 2016

procurements. Since design-bid-build procurements can result in reduced risks to the Authority, evaluation of stations' design packages can be deferred to a later time without increasing the overall risk profile to budget and schedule. Additionally, above ground station construction that occurs before trains reach the testing and operations phase comprise a smaller overall percentage of construction and risks can be controllable.

Structural reviews were also based upon the available information from the Directive Drawings, the Design Criteria Manual, Baseline Geotechnical Reports, and others design documents. The 15% Utility Impact Reports and 15% Design Plans and Profiles designs, including bridge and wall layouts are less developed than would be desired to substantially mitigate design risks. These risks can be controlled through the Authority's continued and comprehensive risk reviews and mitigation processes. Therefore, the probability that the project can be constructed within the cost and schedule required by the funding plan increases. The Authority has demonstrated strong collaboration with the contractor to identify areas of risk, solicit contractor input and incorporate risk mitigation into the design as project development advances.

The aesthetics manual provides guidelines, but not prescriptive aesthetic directives. The Authority reports that the scope of work requires the Contractor to adhere to aesthetic design guidance to implement aesthetic design and visual resource mitigations and enhancements to structures. The Aesthetic Design and Review for Non-Station Structures Report will describe Contractor's approach to implementing these mandatory guidelines.

Geotechnical boring spacing is approximately 1.3 miles between borings. Obtaining additional borings and more detailed geotechnical information could be considered to better inform bidding contractors, reduce cost and reduce risk to the Authority. The Authority has adopted a two-step geotechnical baseline report process where the contractor is to further develop those areas where more detailed geotechnical information is required. The Authority reports that geotechnical data is being improved through follow-on contracts which could reduce some of the risk moving forward. This includes further determination of soil types and conditions. According to the CP1-CP4 Construction documents, the contractors are required to access right-of-way parcels (private at the time of contract execution but scheduled for acquisition by the Authority) and acquire the additional information required to complete the designs. Continued mitigation of these risks into the Authority's risk management and mitigation process will increase the probability to complete the project within the parameters of the Funding Plan.

Several hazardous materials are identified in the Baseline Geotechnical Report and direction is provided to the Contractor to determine the actual hazardous quantities

(5-10% of total soil volume assumed in 6.1.4) of contamination and disposal. The Authority reports that these provisional quantities of hazardous materials will be confirmed by the contractor as the project design is developed and that the risk assessment incorporates contingency to compensate for actual contaminated soil percentages that may be encountered. The existence of hazardous materials can significantly impact budget and schedule if not properly managed.

The PMP and other contract documents include the assignment of liquidated damages in the event of potential contractor non-performance. To better facilitate partnering processes and to support the effectiveness of liquidated damages, the contract documents should include contractor incentives for contractor performance that is ahead of schedule and under budget. In general, contractor incentives may be effective in reducing the occurrence of claims. Incentive compensation can support contractor partnering and offset the reality that collection of liquidated damages (disincentives) is unlikely and often requires costly litigation. However, we do believe the Authority's use of liquidated damages is not an impediment to completing the project as stated in the Funding Plan.

If effectively managed, the CP1-CP4 Construction Packages can be delivered according to the schedule and budget requirements identified in the Funding Plan and we consider the Authority's current management structure and approach as appropriate for these contracts.

3. Suitable and Ready for High-Speed Rail

With the Funding Plan and the associated contract documents and Specifications, the Central Valley segment will be suitable and ready for high-speed train operations as stated in Assembly Bill ("AB") 1889 and as proposed in the Funding Plan as well as the 2016 Business Plan. As described in Section 2.2, the civil works elements of the Funding Plan are under construction and the remaining rail infrastructure elements for the Central Valley segment are planned and accounted for in the Funding Plan. On completion of the project, the usable segment will be suitable for testing of high-speed trains. The implementation of the additional investments required by the Authority to begin high-speed train operations, such as completion of the remaining portion of the Valley to Valley Line between San Jose and Madera, are planned and accounted for in the 2016 Business Plan – an approach confirmed in the June 8, 2012 Office of Legislative Counsel Letter[27].

The civil and track elements in the Funding Plan, from a technical point of view, could accommodate the San Joaquin service at an earlier date than the full scope proposed in the Funding Plan. This is driven by the fact that the San Joaquin service will operate diesel locomotives and so therefore would not require the associated electrification infrastructure.

This opinion is based on the preliminary Track and Systems Performance and Technical Specifications provided to PFAL, and is subject to change depending on the final specifications and designs for the rail infrastructure elements.

[27] Office of Legislative Counsel Letter, June 8, 2012: "the initial (Central Valley) segment by itself is not proposed to be used for high-speed train service until the later completion of the IOS."

4. Passenger Service Compatibility

Based on the material PFAL has reviewed, there are no expected impediments to passenger train service in the Central Valley segment once it is connected to other parts of the high-speed rail network or conventional rail trackage.

4.1 SUITABILITY OF SIGNALING SYSTEM

The signaling system adopted by the Authority must be fit for the purpose of operating high speed passenger trains. To understand the suitability of the train entitled control system specified for the HSR system, the review has examined the document Track and Systems Performance and Technical Requirements. There are some requirements in that document that do not reflect contemporary practice for the deployment of ERTMS systems. For example, the line item budget for Signaling and Communications shows an expectation that track circuits would be used. However, modern signaling projects are taking advantage of communications based technology that avoid the use of track circuits because those technologies can reliably and safely determine train positions. Track circuits then become superfluous and the system life cycle cost is reduced because track circuits do not need to be maintained. Discussions with the Authority suggest that track circuits were intended to provide reliable broken rail detection. Experience indicates that broken rails mostly appear at or near rail joints. In these cases, the track circuits are unaffected because, although the rail is fractured, the fracture occurs within the limit of rail bonding or securing and is therefore not detected. Only 30-50% of broken rails are detected by track circuits. There are modern forms of broken rail detection that do not require reliance of track circuits but these would not necessarily be supplied by a signaling contractor.

While track circuits will not prevent HSR service, other approaches may be more efficient.

4.1.1 Positive Train Control

The Authority's specifications provide for continuous train detection, interlocking of turnouts and junctions, limit of movement Authority commands and on board monitoring of train speed and train responses to commands. These specifications are consistent with the federal legislation requiring positive train control for all rail systems.

4.1.2 Signaling and Communications Risk

As discussed in Section 2.5.2 above, it is the finding of this review that the signaling and communications budget is insufficient to provide all the design, software preparation and equipment installation required to provide an effective working

solution. Nevertheless, PFAL believes that the total cost estimate for the Central Valley segment is adequate to deliver the Track and Systems scope of work for the Central Valley Segment.

4.2 ROLLING STOCK COMPATIBILITY

The rolling stock for the Authority is specified in the document “Schedule 1 Part A: Authority Tier III Trainsets Performance Specification”. This document provides a basic performance specification for the passenger fleet and it appears to be compatible with the other systems described in “Track and Systems Performance and Tech Requirements” document. The responses to the expression of interest notice showed that there are enough companies available and interested (9) to provide a good base for competitive tendering. Accordingly, PFAL does not expect any issues with respect to rolling stock compatibility.

4.3 SUITABILITY OF THE ELECTRIFICATION SYSTEM

The use of the Energy TSI (or equivalent) standard should ensure that a supplier will offer a proven product that will provide for interoperability and that is compatible with the proposed trains.

5. Operating Subsidy

Any high-speed train service contemplated by the Authority is outside the scope of this Funding Plan. Section C of the Funding Plan indicates the Authority will not operate stand-alone High-Speed Train Service in the Central Valley segment until the rest of the Valley to Valley Line, as defined in the Authority's 2016 Business Plan, is completed and connected to the Central Valley segment. This is also reflected in the Ridership and Revenue Forecasting Technical Supporting Document to the 2016 Business Plan which assumes High-Speed Train Service after the Valley to Valley line is connected. Since no standalone Authority High-Speed Train Service will be provided in the usable segment as defined in the Funding Plan, no operating subsidy is contemplated by the Authority. We understand that passenger rail service provided by San Joaquins will not result in any unreimbursed operating or maintenance cost to the Authority.

6. Risks and Risk Mitigation Strategies

The Authority has a well-developed risk management process that includes industry standard risk identification, quantification and assessment procedures for the work elements that are in construction and ready for procurement. The risk analysis includes cost risks and schedule risks with their associated cost impacts. The risk assessment results are used to establish cost contingency amounts for each work package. Although the risk assessment process identifies potential time extensions due to schedule risks, it is not apparent how or if these results are used to inform the schedule forecast for completion of the work packages or the overall program.

DB contracts have been awarded and NTP has been issued for all of the civil works for the Central Valley segment as CP 1-4. Caltrans is managing and has issued a CM/GC contract for realignment of a portion of SR99 required to accommodate HSR. Construction is underway on CP 1 and SR99 and design is in progress on the other construction packages. With the execution of the DB contracts for $3.2 billion of the $7.8 billion total budgeted cost for the Central Valley segment, a substantial amount of design and construction risks have been transferred to the contractors completing CP 1-4. The remaining risks for the civil works include third Party coordination (primarily railroads and utility companies), differing site conditions risks and risks associated with Authority support of construction (primarily right-of-way delivery delays), and interface risks among the civil works contracts and between the civil works and follow-on work for the installation of rail infrastructure.

Risks that have impacted the cost and schedule of the civil works to date include delayed delivery of right-of-way resulting in delayed start of construction and expanded scope for relocation of utilities for CP 1. The CP 1 budget also was increased to extend the line northward toward Madera. The Authority reports that delayed delivery of right-of-way for construction remains a risk that could further impact the cost and schedule of the civil works, but the overall impact has been reduced through mitigation measures including targeting acquisition efforts to critical right of way parcels.

Detailed descriptions of specific risks, probabilities of occurrence, projected impacts and mitigation strategies are considered confidential information by the Authority and were not transmitted for review. The Authority provided an overview of the current risk registers for CP1-4. Based on the overview provided, the risk registers appear to identify the significant risks for each work package and they are being used by

project managers to mitigate the cost and schedule impacts of the potential risk events.

The review finds that the budgeted costs for the active construction packages reflect industry standard risk assessment. The level of contingency appears adequate to address the cost impact of the identified construction risks, including impacts to construction management and other costs not included in the construction contracts. With respect to the project schedule, the review concludes that there is no evidence that the results of the risk assessment have been used to establish risk-based forecasts of the completion dates for the active construction packages or to determine potential schedule delays for follow-on work. It is recommended that the Authority incorporate the results of the risk assessments in its schedule forecasting process.

Project level risk assessment are only conducted for construction packages that are nearing procurement or are underway. The budget values for the cost of other elements of the program are established using typical percentage mark-ups to the base cost estimate. These percentages and the resulting contingency amounts are not divulged in routine cost reports, being embedded in a total cost forecast. The Authority reported that the cost estimate for the Rail Infrastructure work currently reflects a 10 to 25% contingency for individual line items and an overall contingency of 5% for the work package. The resulting 15 – 30% contingency amount is within the range of the FTA recommended contingency range level for projects that are early in the engineering phase of development.

The Authority is initiating a risk assessment for the Rail Infrastructure work package. The Authority reported that its risk informed contingency analysis led it to update the contingency level for CP 2-3 from that carried during the project development phase. Although the risks for the Rail Infrastructure work are different from those for the civil works, the contingency for this upcoming contract may well need to be increased after the risk assessment is completed.

Risk-informed contingency assessment has not been completed for non-construction components of the program budget, such as real estate, construction management services and program-level costs and the budgets for these items do not disclose any embedded contingencies. Given the Authority's robust risk management approach to the construction packages, the expectation is that a streamlined version of the risk-based cost approach would be applied to all aspects of the program and that the resulting contingency values would be presented in cost monitoring reports. This approach would facilitate a more robust contingency management and evaluation process that could inform better cost estimates for future elements of the overall HSR

program. At a minimum we recommend that embedded contingency amounts be reported for all components of the Central Valley program.

After our review of the Central Valley segment and its associated risk management approach, we believe that while risks certainly exist, the Authority has developed an appropriate industry-standard risk management process to manage and mitigate those risks. We find that additional steps will need to be taken to manage the risks that come with the upcoming Track and Systems procurement but the Authority appears to be taking those steps as that contract advances. The overall cost, funding, and contingency appears adequate and our overall assessment is that the major risks have been recognized and measures are being taken to mitigate or account for those risks in the project budget.

6.1 INTERFACE RISKS

There is a wide range of interfaces and therefore a wide range of risks. In this review, this is observed particularly in the Track & Systems specification, where a number of technical disciplines are included and where it is specified that the contractor will be responsible for integration. The Authority will need to monitor this integration and assist in mitigation where necessary, particularly in respect of dealing with interfaces with utilities and other bodies external to the main contract.

6.2 TRACK AND SYSTEM BUDGET RISK

Our review has noted that the overall Track and Systems budget should be sufficient for the project to be successfully completed. However, our review of the details of the Signaling and Communications line item budget will require additional precision as the project progresses to provide the level of detail for oingoing project management oversight and control. Accordingly we recommend that each line item undergo a detailed review with “best in class” benchmarking.

7. Conclusions

Having completed our analysis of the Funding Plan, PFAL's conclusions are as follows:

SHC 2704.08(d)(2) requirements	PFAL Opinion
Construction of the corridor or usable segment thereof can be completed as proposed in the Funding Plan	We have made observations on areas where we believe certainty in available funding and the construction program delivery could be improved. Overall, our conclusion is that the Central Valley segment can be completed from a technical and financial perspective as proposed in the Funding Plan subject to the Authority implementing its planned risk mitigation strategies, project management enhancements and effective execution of proposed contracts.
If so completed, the corridor or usable segment thereof would be suitable and ready for high-speed train operation;	We conclude that the Central Valley segment, upon completion, will meet the requirement of being "suitable and ready" for high-speed train operation as defined in Assembly AB 1889.
Upon completion, one or more passenger service providers can begin using the tracks or stations for passenger train service;	Following completion of the work described in the Funding Plan, our conclusion is that there will be no expected impediments to passenger train service on the Central Valley segment.
The planned passenger train service to be provided by the Authority, or pursuant to its authority, will not require an operating subsidy;	The Authority does not contemplate passenger train service in this Funding Plan. Therefore, PFAL is unable to draw a conclusion regarding the potential requirement for an operating subsidy.
An assessment of risk and the risk mitigation strategies proposed to be employed.	We have made observations on specific risk mitigation strategies that the Authority has in place or will undertake in the prosecution of the work described in this Funding Plan. Based on the information we reviewed, PFAL concludes that the Authority has a well-developed risk management process that includes industry standard risk identification, quantification and assessment procedures for the work elements that are in construction and ready for procurement.

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Appendix II – Document Request

Notes of a Telephone Conference Call

Date: Thursday 10 November 2016

Subject: CHSR Technical Discussion: Shared Use Corridor

Call Participants:

John Popoff -HSR	(NB)
Greg Tseng - PFAL	(GT)
Les Elliott - FCP	(LE)
Piers Connor - FCP	(PC)
Noel Broadbent - FCP	(NB)

Discussion centered mainly around the details contained in a brief produced by NB, key issues discussed were noted as follows, additional post meeting comment provided by JP has been incorporated in these notes

1. The Capltrain specification and contract with the DB Contractor does not comply with some of the initial CHSRA requirements (dated 2010) for the electrification of the shared use corridor. JP said that the authority was aware of this and had been party to the decision to award the DB contract. Additionally JP has commented that the 2010 requirements assumed a dedicated HSR alignment to be constructed, owned and operated by CHSRA – as a result, the technical specifications were CHSR specs. When the Legislature required that the section from SJ-SF be a blended operation (i.e., CHSR would be operating on Caltrain property and the train operations blended) we became tenants on the Caltrain property. At that time we reviewed the Caltrain proposed specifications to make sure that they were suitable for the CHSR equipment and planned operations and are satisfied that our trains will work satisfactorily on the Caltrain Electrification.
2. The HSR refers to the use of international standards,(see response to 1.) the ones contained in the Caltrain specification were out of date. JP said that he expected the current standards to be applied.
3. Noted that legal requirements in California requires compliance with PUC general orders that the Authority believes need amending to allow the construction of a 25 kV railroad. The risk of any amendments in the Caltrain corridor lies with the JPB. JP said that the Authority view now was that these requirements did not apply to the high speed route. We need to keep the Caltrain territory and the CHSR territory separate. CHSR has a new GO 176 that covers the electrification of a dedicated high-speed line – we were the proponents of that GO and will comply with it. GO 176 does not apply to the Caltrain blended section (where there are freight trains, Caltrain trains, ACE, Amtrak and CHSR trains operating – Caltrain has filed with the PUC an application for a GO to cover this territory. CHSR has reviewed Caltrain's application and has provided minor comments to CPUC- but see no reason why we could not operate within the confines of the proposed GO. We expect that the CPUC will implement the new GO for the Caltrain blended sections imminently.
4. The specification for traction power was for 110 mph running, not 125 mph. JP explained that the existence of many at grade crossings meant that they accepted 110 mph was acceptable. (post meeting note - is any capacity being built into the supply for any future load growth?) JP has commented It is extremely unlikely that the SF-SJ route will be fully grade separated and the curves aligned to allow 125 mph running (the curve adjustment would require significant deviation from the existing ROW. In any event, the increase in electrical demand from 110 mph to 125 mph is easily covered by the thermal capacity of the Power Transformers.
5. The OCS design is for 79 mph and will accommodate running at 110 mph in future. JP believes that it is being built to allow 110 mph without further modification.
6. The Authority specified a sagged construction of OCS but a non-sagged design has been specified by Caltrain. (See note 1) JP said that provided current collection was satisfactory they will accept this. At low speeds we do not foresee a problem with current collection.
7. The contact wire height specification is at variance with CHRSA requirements. JP explained that the need to accommodate other trains determined the difference in height. See notes 1 & 3. CHSR specs assume that only CHSR train are operated. The Caltrain specs assume that a variety of train dynamic envelopes must be accommodated including double stack freight traffic – hence the different contact wire height
8. NB noted that back to back cantilevers were not to be used on the high speed line but were likely to be used by Caltrain. Such cantilevers did not provide for mechanical independence necessary for reliable performance. JP understood the reasons why Caltrain might use them and confirmed they would not be

used on the high speed sections. (See note1) Back to back cantilevers are undesirable but, due to environmental constraints Caltrain has been forced into using them in selected (limited) areas. They are not contemplated for use on the CHSR sections.

9. NB noted that the DB contractor was at risk for meeting unspecified PG&E quality standards for harmonic distortion etc. JP explained that the Authority had carried out work with PG&E at a weak point in their 115 kV distribution system and was satisfied that requirements could be met. He further said that the results of this work would be made available to the DB Contractor and that the supply system was more robust in the San Francisco area.
10. NB commented that the lack of a final OCS design had caused cost and program overruns with other projects and that geotechnical surveys were paramount in getting foundation design right first time. JP said that there was good geotechnical knowledge of likely ground conditions along the Caltrain corridor and that the DB contractor seemed to be relaxed about the issue.
11. PC queried the program to remove at grade crossings and noted that any such work after electrification would have to fund necessary changes to the OCS. JP noted that it had been an aspiration for many years to eliminate such crossings but the reality is that the work is not funded and is extremely unlikely to be funded before the PCEP is completed.
12. PC asked what leverage could be exerted by the DB contractor with local utility owners. JP commented that Caltrain has granted the licenses/easement to the utilities, Caltrain had good knowledge of the position of utilities and had influence with the owners.

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